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ABSTRACT

The purpose of this investigation was to determine how well Down Syndrome (DS) adolescents and young adults, relative to other mentally handicapped (MH) individuals, comprehend single words and simple sentences. Samples of 26 DS and 26 MH individuals were matched on intelligence and chronological age and were administered audiological, language, and memory tests. Results suggested that although DS and MH peers show similar understanding of single words and simple grammatical constructions, DS individuals are less able to understand grammatically difficult sentences--a limitation that may reflect, in part, a general difficulty with precisely remembering sequences of spoken words. Multiple partial correlations (with the effects of intelligence and chronological age statistically removed) further indicated that for each group: (1) sentence and word comprehension were unrelated; (2) sentence comprehension was positively related to expressive language ability and auditory short-term memory; and (3) neither sentence nor word comprehension correlated with hearing sensitivity. (31 references) (JDD)

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Language Comprehension in Down Syndrome and Other Trainable Mentally Handicapped Individuals

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Abstract

The purpose of the present investigation was to determine how well Down Syndrome adolescents and young adults, relative to other mentally handicapped (MH) individuals, comprehend single words and simple sentences. Samples of 26 DS and 26 MH individuals were matched on intelligence and chronological age. Each subject was transported to the College for a day of individualized testing (audiological, language, memory) and play during summer vacation. Language comprehension tests were the Picture Vocabulary Test, a measure of individual word meaning, and the Miller-Yoder Language Comprehension Test, a measure of grammatical understanding. In both tests the subject pointed to one of four drawings that best represented the word or sentence spoken by the examiner. The groups did not differ in their ability to comprehend word meanings, $t(50)=0.892$, $p=.377$, or sentences, $t(50)=1.397$, $p=.169$. A more detailed investigation of sentence comprehension conducted by clustering Miller-Yoder items into three types (easy, moderate, or difficult, based on developmental difficulty level) revealed that DS subjects, relative to MH subjects, showed poorer understanding of grammatically difficult sentences (e.g., verb inflection, passive voice), Wilks' Lambda $F(3,48)=3.803$, $p=.016$. Multiple partial correlations (with the effects of IQ and CA statistically removed) further indicated that for each group: a) sentence and word comprehension were unrelated; b) sentence comprehension was positively related to expressive language ability and auditory short-term memory; and c) neither sentence nor word comprehension correlated with hearing sensitivity. The results suggested that although DS and MH peers show similar understanding of single words and simple grammatical constructions, DS individuals are less able to understand grammatically difficult sentences--a limitation that may reflect, in part, a general difficulty with precisely remembering sequences of spoken words.

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Language Comprehension in Down Syndrome and Other
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Although it is well known that Down syndrome (DS) children and adolescents are prone to difficulties in hearing (e.g., Dahle & McCollister, 1986; Wilson, Folsom, & Widen, 1983) and speaking (e.g., Dodd, 1976; Layton & Sharifi, 1978), less is known about their listening and understanding skills (Miller, 1987). This is unfortunate in light of the finding that maximal estimates of language ability in mentally handicapped individuals are obtained in verbal comprehension tasks not requiring verbal expression (Walker, Roodin, & Lamb, 1975).

Studies with only DS children and adolescents (Cornwell, 1974; Evans, 1977; Semmel & Dolley, 1971; Sommers & Starkey, 1977; Whiteman, Simpson, & Compton, 1986) or DS individuals and a nonretarded comparison group (Bridges & Smith, 1984; Holdgrafer, 1981, 1982; McDade & Adler, 1980), suggest difficulties in verbal comprehension tasks requiring non-spoken responses. However, because of the absence of a non-DS mentally handicapped (MH) comparison group, it is unclear whether comprehension difficulties were associated with Down syndrome or mental retardation in general.

A smaller set of studies--one in which DS and MH children and adolescents were compared on verbal comprehension tasks not requiring verbal production--allows an evaluation of the possibility that DS individuals have language comprehension difficulties beyond those associated with moderate to severe mental retardation. In the realm of word comprehension, Marcell and Croen (1989) found that DS and MH subjects matched on global receptive vocabulary ability did not differ in their identification of different categories of words (e.g., action verbs--"peeling"; household items--"vase") on the Peabody Picture Vocabulary Test. In the realm of sentence comprehension, however, investigators have reported DS-MH performance differences on subtests of the Stanford-Binet (Silverstein, Legutki, Friedman, & Takayama, 1982), the Illinois Test of Psycholinguistic Abilities (Burr & Rohr, 1978), and the Token Test (Hartley, 1982, 1985). These researchers found that DS subjects less accurately: a) identified objects by use (e.g., "Show me the one we drink out of") (Silverstein et al, 1982), b) responded (with a gesture or a simple "yes/no") to sensible and nonsensical questions ("Do caterpillars crawl?"; "Do dishes yodel?") (Burr & Rohr, 1978), and c) arranged tokens in response to commands requiring the processing of several variables in either a straightforward (e.g., "Touch the red circle and the blue square") (Hartley, 1982) or syntactically more complex (e.g., "Before touching the yellow circle, pick up the red square") (Hartley, 1982, 1985) sentence.

It is possible, then, that DS and MH peers show similar understanding of single spoken words, but differ in their ability to understand and remember lengthier word sequences. The purpose of the present investigation was to explore how well DS adolescents and young adults, relative to non-DS mentally handicapped individuals, comprehend single words and sentences of varying grammatical types. Because DS individuals appear to show a pattern of increasing language difficulty (relative to their general cognitive status) as they get older (Miller, 1987), the use of older subjects should have

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maximized differences between DS and MH peers. Expressive language, auditory short-term memory, and hearing abilities were also measured in order to explore their relationship to comprehension ability.

Method

Subjects

Samples of 26 DS and 26 MH individuals were recruited from trainable mentally handicapped programs in eleven public schools (N=44), a residential institution (N=2), and two community programs for mentally handicapped adult citizens (N=6) in the Charleston, South Carolina, area. Although an attempt was made, through permission letters and telephone discussion with parents, to recruit participants with "understandable" speech and knowledge of the numbers 1-9, four children (three DS and one MH) with especially difficult-to-understand speech (subjectively determined by the experimenters) and two children (both MH) unable to recognize, by sight, all nine digits, were included in the final samples. The samples were matched on Stanford-Binet IQ [mean DS IQ=39.7 (SD=7.3) and mean MH IQ=40.9 (6.2), $t(50)=.616$] and chronological age [mean DS CA=226.1 months (SD=40.3) and mean MH CA=225.0 months (SD=40.5), $t(50)=.096$]. An additional seven participants were excluded from the study because of no speech (two MH), an inability to understand (or failure to cooperate during) 40% or more of the tasks (three DS and one MH), or later discovery of educable (rather than trainable) school placement (one MH).

Materials and Apparatus

Two measures of language comprehension were employed. One was the Picture Vocabulary Subtest of the Test of Language Development-2 Primary (TOLD-2P; Newcomer & Hammill, 1988), a 35-item test of individual word meaning that requires the individual to point to one of four drawings that best represents the word spoken by the examiner. Testing began with item one and continued until five consecutive items were missed. In the TOLD-2P theoretical model, the Picture Vocabulary Subtest measures semantic knowledge (vocabulary) and requires only listening (receptive language) skills. The second measure of language comprehension was the Miller-Yoder Language Comprehension Test (MY; Miller & Yoder, 1984), an 84-item test of grammatical understanding in which the individual points to one of four drawings that best represents the sentence spoken by the examiner. For example, the test plate for the spoken sentence, "Mother is kissed by father," contains the appropriate drawing and three distractor drawings: one of mother kissing father and two of sentences of the same grammatical form with different actors and actions (a boy pushing a girl in a car and vice-versa). Each item is a 4- or 5-word sentence that assesses understanding of one of ten basic grammatical forms (e.g., pronouns, possession, verb inflection, passive voice). The MY was administered in two sessions (42 items per session).

Expressive language meaures included an oral vocabulary task (defining eight words aloud) and a sentence imitation task (repeating eight spoken sentences) described in detail by Marcell, Sewell, and

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Croen (1990). A cassette tape recorder and external microphone were used to record speech. Other tests included an auditory short-term memory task (digit recall) and three computer-based memory tasks (not reported here). Creation of auditory digit sequences was made possible by an Ani-Vox Professional Computer Speech System (Animated Voice Corporation) used in conjunction with an IBM PS/2 Model 30 computer. The numbers 1-9 were spoken by a male, digitized, editted, and pretested for 100% intelligibility in a sample of 10 nonretarded 5-year-old children. The digits were combined into random sequences 2-7 digits long, with the speaker's voice pitch dropping on the last digit. The average duration of a digit was 609 msec and the pause between digits was 900 msec. A comprehensive audiological assessment was administered by clinical audiologists; the pure tone air conduction and speech reception threshold measurements are described by Marcell, Cohen, Weathers, Wiseman, Croen, and Sewell (1990).

Procedure

Each subject was transported to the College of Charleston for a day of individualized testing and play during summer vacation. One or two participants were seen daily by two or three experimenters, with the typical day beginning at 9 am and ending at 2:30 pm. The testing agenda included an audiological assessment at the Charleston Speech and Hearing Center, standardized language subtests, and computer-oriented memory experiments, with the latter two types of tasks presented in a random order. The play agenda (which included computer games, a trip to the College gameroom, an outdoor picnic, a crafts project, and a visit to a marine biology specimen display) was employed flexibly according to the subjects' needs and testing schedule.

Three sound-attenuated rooms in the Psychology Department's Observation Suite were alternately shared by experimenters and participants. One room contained a computer terminal, Ani-Vox speaker, and chairs and was used for presentation of memory tasks. A second room contained a microphone, tape recorder, table, and chairs and was used for language testing. The third room was brightly decorated and contained a sofa, lounge chair, radio, and games; it was used as a rest, play, and crafts area. Each room had an adjacent observation area equipped with one-way mirror and microphones; parents were invited to observe at any time during the day-long session.

Results

Picture Vocabulary Analysis

The total number of items correctly identified on the TOLD-2P Picture Vocabulary Subtest was tabulated for each subject. The groups did not differ statistically in their ability to identify word meanings: DS mean=12.2 (SD=4.5), MH mean=13.5 (SD=6.0), $t(50)=0.892$, $p=.377$.

Miller-Yoder Analyses

Total Score Analysis. The total number of sentence pairs correctly identified out of 42 was

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tabulated for each subject (Miller & Yoder, 1984). The groups did not differ statistically in their general ability to comprehend sentences: DS mean=15.9 (SD=6.6), MH mean=19.0 (SD=9.1), $t(50)=1.397$, $p=.169$. Rescoring the MY for number of sentences (rather than number of sentence pairs) correctly identified did not alter the results: DS mean=50.9 (SD=9.5), MH mean=55.4 (SD=11.9), $t(50)=1.522$, $p=.134$.

Grammatical Forms Analyses. A finer-grained investigation of grammatical comprehension was made by tabulating the number of sentence pairs correctly identified in each grammatical form category and converting the figure to a proportion score (e.g., a subject who correctly identified three of the four preposition sentence pairs received a score of .75). The 10 grammatical forms were then combined and reduced to three types based on developmental difficulty level: easy (preposition), moderate (pronoun, active, negative-affirmative, modification), and difficult (singular-plural, possessive, reflexivization, verb inflection, passive). Types were based on the average approximate age at which 70% or more of the MY normative sample correctly identified the constituent grammatical forms: easy (4 years), moderate (5 years), and difficult (6.5 years). Multiple t tests confirmed that for each group, performance was better on easy items (DS mean=.71, MH mean=.71) than moderate items (DS mean=.436, MH mean=.478), and performance was better on moderate items than difficult items (DS mean=.203, MH mean=.344) (all differences significant at $p<.0001$).

The three dependent variables were next entered into a MANOVA with one independent variable (group membership). Checks for univariate and multivariate outliers, multicollinearity, singularity, and univariate homogeneity of group variances revealed no threats to multivariate analysis (Tabachnick & Fidell, 1989). The MGLH module in SYSTAT (Wilkinson, 1987) revealed an effect of group membership, Wilks' Lambda $F(3,48)=3.803$, $p=.016$. The significant discriminant function [Bartlett's (3)=10.342, $p=.016$] was defined solely by difficult items (canonical loading=-.786). The DS group identified fewer grammatically difficult sentences than the MH group.

Correlational Analyses

Correlations were computed between language comprehension measures and measures of expressive language, auditory short-term memory, and hearing ability. Partial correlations (each evaluated at alpha=.05) were used in order to remove the effects of IQ and CA.

Picture Vocabulary. Neither DS nor MH subjects showed a relationship between picture vocabulary performance and performance on the total MY or any of the three types of MY items. Likewise, DS and MH picture vocabulary performance was not associated with sentence imitation, oral vocabulary, auditory short-term memory, hearing sensitivity, or speech reception threshold measures.

Miller-Yoder. In contrast, both groups showed significant correlations between MY total score and sentence imitation [DS $r(22)=.420$; MH $r(23)=.615$] and oral vocabulary [DS $r(23)=.572$; MH

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$r(23)=.501$]. The relationship between MY total score and auditory recall of digit sequences was significant for the MH group [$r(21)=.562$] and approached significance in the DS group [$r(23)=.381$ (critical $r=.396$]. MY total score did not relate to hearing ability in either group.

The two most widely differing types of MY items--easy and difficult--were used to determine whether MY performance patterns varied by difficulty level. For DS subjects, performance on easy MY items did not relate to performance on expressive language or auditory short-term memory tasks. However, performance on difficult MY items correlated with both sentence imitation [$r(23)=.514$] and auditory short-term memory [$r(23)=.414$]. For MH subjects, easy items correlated with sentence imitation [$r(23)=.419$] and auditory short-term memory [$r(21)=.463$], and hard items correlated with sentence imitation [$r(23)=.511$], oral vocabulary [$r(23)=.506$], and auditory short-term memory [$r(21)=.480$]. Once again, neither group showed a relationship between MY item type and hearing ability.

Discussion

The results suggested that DS and MH individuals possess different profiles of language comprehension ability. Although both groups demonstrated similar understanding of single vocabulary words and grammatically easier sentence constructions, DS individuals seemed less able to understand sentences with more difficult sentence constructions. These results conceptually replicated the word comprehension findings of Marcell & Croen (1989), qualified earlier reports of DS-MH sentence comprehension differences (Burr & Rohr, 1978; Silverstein, 1982), and closely paralleled Hartley's (1982, 1985) finding of poorer DS than MH comprehension in tasks requiring processing of syntactically complex relationships. Overall, the results suggest that: a) DS and MH adolescents show similar levels of lexical ability, a language skill considered by some (e.g., Rondal, 1978) to be basic and relatively simple; and b) sentence comprehension difficulties exist in DS adolescents and adults that are not simply a function of general mental retardation or poor hearing ability.

Although we cannot explain why DS subjects showed poorer comprehension of difficult sentences than MH subjects, the correlational analyses suggested a possibility. Understanding of difficult sentences was associated, in both groups, with the ability to repeat, verbatim, sentences and strings of digits. This finding, together with the absence of any relationship between comprehension of single words and sentences, suggests that poor comprehension of difficult sentences may have reflected difficulty in precisely remembering sequences of words. For instance, poor memory for word order in a difficult MY sentence like, "Show me the boy's daddy," might have resulted in selection of the distractor, "Show me the daddy's boy." Similarly, a mental switching of the position of the "s" in the difficult MY sentence, "The cat climbs the tree," might have led some to point to, "The cats climb the tree." In the same vein, easier MY sentences like, "The little dog is sleeping," or "Spot stands under the bed," might have been less confused with their distractors ("The big dog is sleeping," "Spot stands on the bed") because memory for word order was not essential for comprehension.

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It is hypothesized, then, that DS and MH comprehension will be similar when meaning is extracted from speech containing individual words, short sentences, or sentences in which the "gist" can be obtained without attention to word order (as in much natural conversation). However, if the information in spoken sentences exceeds short-term memory capacity and/or requires careful attention to word order for precise understanding, then DS comprehension will tend to be less accurate than that of their MH peers. This is similar to the conclusion drawn by Vallar & Baddeley (1984) in work with adults with left hemisphere damage. It is also consistent with conclusions drawn by cognitively-oriented investigators who stress the limits of DS auditory short-term memory (e.g., Marcell & Weeks, 1988; McDade & Adler, 1980; Varnhagen, Das, & Varnhagen, 1987) and successive processing ability (e.g., Ashman, 1982; Hartley, 1982; Snart, O'Grady, & Das, 1982).

In summary, the results suggest that Down syndrome adolescents and young adults do not differ from non-Down's mentally handicapped peers in the comprehension of vocabulary words and simple grammatical sentences, but do differ in the understanding of more grammatically difficult sentences. These findings contribute to an emerging profile of DS language comprehension ability in which a) simple listening and understanding abilities are equivalent to those of other trainable mentally handicapped individuals, but b) limitations appear when auditory short-term memory capacity is exceeded and/or when precise sequences of auditory-verbal information need to be remembered.

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